PATENT ABSTRACTS OF JAPAN

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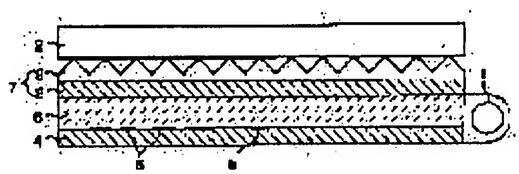
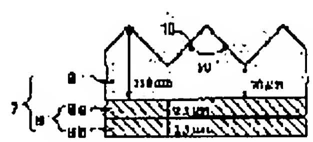
(54) DIMMER SHEET

(57)Abstract:

PURPOSE: To efficiently exhibit both of a light diffusion function and a screen lightness maintaining function by increasing the degree of refraction in each layer of light diffusing layers as it is positioned closer to the incident face side and forming an outgoing face of a light converging layer into a rough surface.



CONSTITUTION: A fluorescent lump 1 serving as a light source is arranged in one side end part. of a light leading plate 6 provided with dot patterns on its back face. A reflecting plate 4 is arranged on the back face side of the light leading plate 6, and the front face side of the light leading plate 6, in other words, an outgoing face side is provided with a liquid crystal display device 2 via a dimmer sheet 7. The dimmer sheet 7 is formed into a multilayer structure consisting of a light diffusing laminated body 8 with a two-layer structure of polymethyl methacrylate light diffusing layers 8a, 8a and a polycarbonate light converging layer 9 laminated on the outgoing face (front face) of the light diffusing laminated body 8. The outgoing face (non-laminated face) of the light converging layer 9 is formed into an uneven face 10. This uneven shape has a cross sectional face in which multiple right angled triangles are arranged in parallel to the fluorescent lump 1.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the modulated light sheet built into the surface light source equipment used for liquid crystal display devices, such as a computer and a word processor.
[0002]
[Description of the Prior Art] Since a liquid crystal display device does not have a private luminescence, in order to raise visibility, it carries out the need of the lighting of the from else. In view of this, the surface light source equipment which irradiates light from the tooth back of a liquid crystal display component to a liquid crystal display component is developed. In the time of development, although surface light source equipment had taken the back light type structure which has arranged the light source of a fluorescent lamp etc. directly at the tooth back of a liquid crystal display component, in order to make thin thickness of the whole surface light source equipment and to attain the small thinning of a device, recently, it takes the structure of the edge light type which has arranged the light source in the side edge section of a liquid crystal display component in many cases.
[0003] Drawing 9 shows the basic structure of back light-type surface light source equipment. In drawing 9 , the fluorescent lamp 1 as the light source is arranged through the optical diffusion sheet 3 at the tooth-back side of the liquid crystal display component 2. In this case, a fluorescent lamp 1 is arranged in the center of a front face of a reflecting plate 4, and the layer-like liquid crystal display component 2 is formed through the optical diffusion sheet 3 ahead of the reflecting plate 4.
[0004] Drawing 10 shows the basic structure of edge light-type surface light source equipment. In drawing 10 , the fluorescent lamp 1 as the light source is arranged at the side edge section of a light guide plate 6 which has a dot pattern 5 at a tooth back. Laminating arrangement of the reflecting plate 4 is carried out at the tooth-back side of a light guide plate 6, and the layer-like liquid crystal display component 2 is formed in the front face (outgoing radiation side) of a light guide plate 6 through the optical diffusion sheet 3.
[0005] A dot pattern 5 is a printing pattern of the light-scattering nature formed in the tooth back of a light guide plate 6 in order to carry out outgoing radiation equally from every location of the display screen, and it can say this for the light of the fluorescent lamp 1 which carried out incidence to the light guide plate 6 from the side edge side also with the false light source. In case a liquid crystal display device is used for the optical diffusion sheet 3, the dot pattern 5 in the fluorescent lamp 1 or edge light type of the light source, i.e., a back light type, on the back is not checked by looking from the display screen through the liquid crystal display component 2, but it functions as being regarded as the field which is emitting light to homogeneity.
[0006] It divides roughly into two and there are a thing which applied oxide titanium, the staple fiber of glass, etc. to the front face of plastic film or a sheet, or the interior was made to contain, and a thing to which concavo-convex processing was performed on the front face in an optical diffusion sheet. As a former example, the film or sheet cast from the ingredient which added light diffusion agents, such as titanium oxide and a glass staple fiber, is mentioned to resin, such as polyester, a polycarbonate, and

polymethylmethacrylate, as are shown in JP,63-33703,A, and shown in each official report of the thing which applied light diffusion agents, such as titanium oxide and a glass staple fiber, to one side or both sides of a transparent film or sheets, such as polyester, a polycarbonate, and polymethylmethacrylate, or JP,1-209402,A, and JP,1-172801,A.

[0007] As a latter example, some which performed concavo-convex processing of arbitration are in one side or both sides of the film which consists of resin, such as polyester, a polycarbonate, and polymethylmethacrylate, or a sheet as shown in JP,2-13925,A. Moreover, it has the two-layer structure of an optical diffusion layer and a condensing layer, and is made into a concave convex, the non-laminating side, i.e., the outgoing radiation side, of a condensing layer, and the modulated light sheet having the two above-mentioned person's function is indicated by JP,5-173134,A.

[0008]

[Problem(s) to be Solved by the Invention] However, if the optical diffusion sheet shown in each official report of JP,1-209402,A and JP,1-172801,A increases the amount of a light diffusion agent in order to raise an optical diffusion function, it tends to fall the amount of Idemitsu for the obliterating power, and the brightness of a practical screen tends to be insufficient for it.

[0009] Moreover, although the optical diffusion sheet shown in JP,2-13925,A is a thing using light scattering by the shape of surface type of a sheet and it exceeds the former sheet in respect of the amount of Idemitsu, what was excellent about the diffusion function will need to increase the thickness of a sheet or the whole light source unit, in order to obtain sufficient diffusion function since a dot pattern also becomes easy to be visible if it is obtained and thin shape-izes [it is hard and]. Since the thin shape-ized inclination of the latest device makes a fluorescent lamp thin and it is reducing the quantity of light, this fault is a big problem.

[0010] Lightness will be spoiled if it will thicken a sheet in order to spoil optical diffusibility and to raise optical diffusibility conversely if the modulated light sheet shown in JP,5-173134,A improves both fault as a result of making former 2 person's function have, but it makes a sheet thin or the amount of a dispersing agent is reduced, in order that lightness and optical diffusibility may have an antinomy relation and may raise lightness, or it makes [many] the amount of a dispersing agent.

[0011] Moreover, with edge light-type surface light source equipment, since the light which carries out incidence from a light guide plate to an optical diffusion sheet or a modulated light sheet has the inclination to be distributed over the include angle which is [of a screen] separated from a normal as shown in drawing 8 , in addition, lack is in the function which controls distribution of the direction of Idemitsu by the above-mentioned sheet near the direction of a normal. For this reason, the brightness at the time of seeing a screen from a transverse plane becomes weak. The purpose of this invention is to offer the modulated light sheet which demonstrates efficiently the function of optical diffusion and a screen of both lightness maintenance in view of an above-mentioned point.

[0012]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the modulated light sheet by this invention is characterized by consisting of an optical diffusion layer more than two-layer, and a condensing layer installed in the outgoing radiation side side of said optical diffusion layer at least, and the layer to which the refraction degree of each class of said optical diffusion layer is located in a plane-of-incidence side being large, and making the outgoing radiation side of said condensing layer with the concave convex.

[0013] In the suitable example of this invention, it is formed from the compound with which each class of an optical diffusion layer comes to add a transparent light diffusion agent to transparent resin, and is characterized by for the refractive index of the light diffusion agent of each class to be as large as the thing of a layer located in a plane-of-incidence side, or being as large as the thing of the layer to which the particle size of the light diffusion agent of each class is located in a plane-of-incidence side. Especially if the resin which constitutes each class of an optical diffusion layer is transparent resin, it will not be limited, but a polycarbonate, polyester, polymethylmethacrylate, etc. are illustrated as transparent resin.

[0014] As a transparent light diffusion agent, a well-known thing can be applied conventionally, for

example, impalpable powder, such as polymethylmethacrylate, polystyrene, and glass, a staple fiber, a bead, etc. are mentioned. In addition, in the semantics of condensing effectiveness, the globular shape of especially the configuration of a light diffusion agent, i.e., a bead, is desirable. Each optical diffusion layer is formed to transparent resin from the compound which comes to add a transparent light diffusion agent to the sum total of resin and a light diffusion agent five to 70% of the weight still more preferably two to 95% of the weight preferably. Diffusibility with this ratio sufficient at less than 2 % of the weight is not acquired, but when it has arranged in the front face of the light guide plate which has a scattered reflection layer (dot pattern) at the rear face in surface light source equipment, a dot pattern becomes is easy to be checked by looking through a modulated light sheet. Conversely, if it exceeds 95 % of the weight, it will become difficult for the amount of Idemitsu to fall extremely and to distribute a light diffusion agent to homogeneity to resin.

[0015] 10 micrometers or more of thickness of an optical diffusion layer are 10-30 micrometers still more preferably preferably. Sufficient diffusibility may not be acquired if it is less than 10 micrometers. It is the approach of carrying out the solution cast to the condensing layer formed by the approach of carrying out the heat press of the ingredient, the approach of extruding an ingredient by the T die, the flow casting methods, or those approaches as the formation approach of of the film or sheet for optical diffusion layer manufacture etc., and if the Hayes value by the formed layer is 70 - 85% preferably 50 to 90%, especially the approach of formation will not be limited. A diffusion function is inadequate in the Hayes value being less than 50%, and the dot pattern of a tooth-back light guide plate is seen through. On the other hand, if the Hayes value exceeds 90%, the quantity of light which carries out outgoing radiation decreases too much, and the brightness of a screen runs short.

[0016] A condensing layer consists of transparent resin and a polycarbonate, polyester, polymethylmethacrylate, etc. are illustrated as transparent resin. 80 micrometers or more of thickness of a condensing layer are 90-300 micrometers still more preferably preferably. If this thickness is less than 80 micrometers, grant of a configuration required for modulated light may not be able to be performed.

[0017] The non-laminating side of a condensing layer, i.e., ********, is made with the concave convex. The shape of this toothing should just collect more those directions of Idemitsu in the direction of a normal of a screen. What the thing of the shape of the various kinds of shape of a thing and a Fresnel lens which consists of many protruding lines of a cross-section triangle or a hemicycle, and a lenticular lens etc. is illustrated, and has many cross-section abbreviation sine wave-like concave protruding lines preferably is good for this.

[0018] Since the outgoing radiation light distribution from a light guide plate is separated from the normal with edge light-type surface light source equipment, the effectiveness which condenses this distribution in the direction of a normal as the shape of toothing is random is small. On the other hand, although condensing effectiveness is large in the shape of toothing being a cross-section triangle, when an include angle is attached in the direction perpendicular to a concave protruding line from a normal, the fault that the scotoma in which the include angle from which lightness falls rapidly appears occurs tends to produce a look. On the other hand, if the shape of toothing is a cross-section abbreviation sine wave, the appearance of the scotoma can be prevented, having condensing effectiveness.

[0019] Although there are embossing, a monotonous press, etc. as the toothing-like formation approach, carrying out extrusion molding, the concavo-convex formation approach is not limited to these. It does not matter whether the optical diffusion layer and the condensing layer are stuck or air intervenes in the middle, without sticking. Moreover, when making it stick, what kind of well-known means is not cared about at all. The range of 100 micrometers or more of thickness of the whole modulated light sheet is 100-500 micrometers still more preferably preferably. Formation of irregularity [in / that the whole thickness is less than 100 micrometers / the outgoing radiation side of a condensing layer] is difficult.

[0020]

[work --] for The Idemitsu distribution of light is condensed near the normal by passing the condensing layer which was spread while the light which carried out incidence with the distribution which is [of a screen] separated from a normal first according to the configuration like **** could change the travelling direction a lot in the optical high diffusion layer of a refraction degree, could raise the

homogeneity of diffusion in the low optical diffusion layer of a refraction degree after that, and was prepared in the outgoing radiation side side of an optical diffusion layer.

[0021] Since the refractive index of the light diffusion agent used in an optical diffusion layer is as large as a plane-of-incidence side when the modulated light sheet shown by this invention claim 2 has been arranged to edge light-type surface light source equipment, it is spread while the light which carried out incidence with the distribution which is [of a screen] separated from a normal first can change a travelling direction a lot with the light diffusion agent of a high refractive index, and the homogeneity of diffusion can be raised with the light diffusion agent of a low refractive index after that. Thus, it becomes possible to be hard to check a dot pattern by looking and to carry out it at the same time it starts the Idemitsu distribution in the direction more near a normal.

[0022] Since the particle size of the light diffusion agent used in an optical diffusion layer is as large as a plane-of-incidence side when the modulated light sheet shown by this invention claim 3 has been arranged to edge light-type surface light source equipment, it is spread while the light which carried out incidence with the distribution which is [of a screen] separated from a normal first can change a travelling direction a lot with the light diffusion agent of a major diameter, and the homogeneity of diffusion can be raised with the light diffusion agent of a minor diameter after that. Thus, it becomes possible to be hard to check a dot pattern by looking and to carry out it at the same time it starts the Idemitsu distribution in the direction more near a normal. Moreover, since a light diffusion agent also has a condensing function, sufficient condensing effectiveness is acquired, without enlarging the shape of toothing of a condensing layer. Therefore, a possibility that the concavo-convex pattern of a condensing layer may be checked by looking all over a screen also disappears.

[0023]

[Example] The following example explains this invention concretely.

[Example 1] The basic structure of edge light-type surface light source equipment is shown in drawing 1 . The fluorescent lamp 1 as the light source is arranged at the 1 side edge section of a light guide plate 6 which has a dot pattern 5 at a tooth back. A reflecting plate 4 is arranged at the tooth-back side of a light guide plate 6, and the liquid crystal display component 2 is formed in the front-face [of a light guide plate 6], i.e., outgoing radiation side, side through the modulated light sheet 7.

[0024] The modulated light sheet 7 is making the multilayer structure of the optical diffusion layered product 8 of the two-layer structure by the optical diffusion layers 8a and 8b made from polymethylmethacrylate, and the condensing layer 9 made from a polycarbonate by which the laminating was carried out to the outgoing radiation side (front face) as shown in drawing 2 . The outgoing radiation side (non-laminating side) of the condensing layer 9 is the concave convex 10. The shape of this toothing makes the cross-section rectangular equilateral triangle (a vertical angle is a right angle) prepared in parallel with the fluorescent lamp 1 in drawing 1 . [many]

[0025] The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. Independent extrusion performed shaping of the condensing layer 9. The heat press performed concavo-convex formation. The thickness of the condensing layer 9 is 150 micrometers, among those the height of heights is 80 micrometers. The thickness of optical diffusion layer 8a is 25 micrometers, the thickness of optical diffusion layer 8b is 25 micrometers, and the thickness as the optical whole diffusion layer is 50 micrometers.

[0026] After optical diffusion layer 8a applies to the non-concave convex of the condensing layer 9 arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 20 % of the weight to the sum total of this monomer and this bead about a glass bead with a diameter of 15 micrometers, it carries out UV hardening and forms this monomer. After optical diffusion layer 8b applies to the non-laminating side of optical diffusion layer 8a arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 10 % of the weight to the sum total of this monomer and this bead about polystyrene beads with a diameter of 15 micrometers, it carries out UV hardening and forms this monomer.

[0027] [Example 2] The surface light source equipment to be used is the same as an example 1 except for a modulated light sheet. The modulated light sheet 7 consists of a condensing layer 9 made from a

polycarbonate by which the laminating was carried out to the optical diffusion layered product 8 and its outgoing radiation side of the three-tiered structure by the optical diffusion layers 8a, 8b, and 8c made from a polycarbonate as shown in drawing 3 .
[0028] The non-laminating side of the condensing layer 9 is the concave convex 10. The shape of this toothing consists of many protruding lines of the cross-section isosceles triangle arranged in parallel with the fluorescent lamp 1 in drawing 1 . the vertical angle of a protruding line -- 70 degrees -- it is -- a crowning and a pars basilaris ossis occipitalis -- the cross section with a radius of curvature of 20 micrometers -- it is circular. The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. The heat press performed concavo-convex formation.
[0029] The thickness of the condensing layer 9 is 200 micrometers, among those the height of heights is 100 micrometers. The thickness of optical diffusion layer 8a is 10 micrometers, the thickness of optical diffusion layer 8b is 25 micrometers, the thickness of optical diffusion layer 8c is 10 micrometers, and the thickness as the optical whole diffusion layer is 45 micrometers. Optical diffusion layer 8a is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about the bead of polymethylmethacrylate with a diameter of 6 micrometers so that it may become 40 % of the weight to the sum total of this resin and this bead.
[0030] Optical diffusion layer 8b is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about a glass bead with a diameter of 15 micrometers so that it may become 20 % of the weight to the sum total of this resin and this bead. Optical diffusion layer 8c is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about polystyrene beads with a diameter of 6 micrometers so that it may become 10 % of the weight to the sum total of this resin and this bead.
[0031] [Example 3] The surface light source equipment to be used is the same as an example 1 except for a modulated light sheet. The modulated light sheet 7 consists of a condensing layer 9 made from a polycarbonate by which the laminating was carried out to the optical diffusion layered product 8 and its outgoing radiation side of the two-layer structure by the optical diffusion layers 8a and 8b made from polymethylmethacrylate as shown in drawing 4 . .
[0032] The non-laminating side of the condensing layer 9 is the concave convex 10. The shape of this toothing consists of many concave protruding lines of the shape of a cross-section abbreviation sine wave arranged in parallel with the fluorescent lamp 1 in drawing 1 . The amplitude of the sine wave of a concave protruding line is 120 micrometers, a period is 350 micrometers, and the thickness of the condensing whole layer is 200 micrometers. The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. Independent extrusion performed shaping of the condensing layer 9. The heat press performed concavo-convex formation. The thickness of optical diffusion layer 8a is 10 micrometers, the thickness of optical diffusion layer 8b is 60 micrometers, and the thickness as the optical whole diffusion layer is 70 micrometers.
[0033] After optical diffusion layer 8a applies to the non-concave convex of the condensing layer 9 arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 25 % of the weight to the sum total of this monomer and this bead about the bead of polymethylmethacrylate with a diameter of 7 micrometers, it carries out heat curing of this monomer, and forms it. After optical diffusion layer 8b applies to the non-laminating side of optical diffusion layer 8a arrangement **** which adds and becomes to the monomer of methyl methacrylate so that it may become 15 % of the weight to the sum total of this monomer and this bead about polystyrene beads with a diameter of 40 micrometers, it carries out heat curing of this monomer, and forms it.
[0034] [Example 4] The surface light source equipment to be used is the same as an example 1 except for a modulated light sheet. The modulated light sheet 7 consists of a condensing layer 9 made from a polycarbonate by which the laminating was carried out to the optical diffusion layered product 8 and its outgoing radiation side of the two-layer structure by the optical diffusion layers 8a and 8b made from polymethylmethacrylate as shown in drawing 5 . The non-laminating side of the condensing layer 9 is the concave convex 10. The shape of this toothing makes the cross-section rectangular equilateral triangle (a vertical angle is a right angle) prepared in parallel with the fluorescent lamp 1 in drawing 1 .

[many]
[0035] The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. Independent extrusion performed shaping of the condensing layer 9. The heat press performed concavo-convex formation. The thickness of the condensing layer 9 is 150 micrometers, among those the height of heights is 80 micrometers. The thickness of optical diffusion layer 8a is 25 micrometers, the thickness of optical diffusion layer 8b is 60 micrometers, and the thickness as the optical whole diffusion layer is 85 micrometers.
[0036] After optical diffusion layer 8a applies to the non-concave convex of the condensing layer 9 arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 20 % of the weight to the sum total of this monomer and this bead about a glass bead with a diameter of 15 micrometers, it carries out UV hardening and forms this monomer. After optical diffusion layer 8b applies to the non-laminating side of optical diffusion layer 8a arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 10 % of the weight to the sum total of this monomer and this bead about a glass bead with a diameter of 40 micrometers, it carries out UV hardening and forms this monomer.
[0037] [Example 5] The surface light source equipment to be used is the same as an example 1 except for a modulated light sheet. The modulated light sheet 7 consists of a condensing layer 9 made from a polycarbonate by which the laminating was carried out to the optical diffusion layered product 8 and its outgoing radiation side of the three-tiered structure by the optical diffusion layers 8a, 8b, and 8c made from a polycarbonate as shown in drawing 6 .
[0038] The non-laminating side of the condensing layer 9 is the concave convex 10. The shape of this toothing consists of many protruding lines of the cross-section isosceles triangle arranged in parallel with the fluorescent lamp 1 in drawing 1 . the vertical angle of a protruding line -- 70 degrees -- it is -- a crowning and a pars basilaris ossis occipitalis -- the cross section with a radius of curvature of 20 micrometers -- it is circular. The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. The heat press performed concavo-convex formation.
[0039] The thickness of the condensing layer 9 is 200 micrometers, among those the height of heights is 100 micrometers. The thickness of optical diffusion layer 8a is 10 micrometers, the thickness of optical diffusion layer 8b is 25 micrometers, the thickness of optical diffusion layer 8c is 40 micrometers, and the thickness as the optical whole diffusion layer is 75 micrometers. Optical diffusion layer 8a is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about the bead of polymethylmethacrylate with a diameter of 6 micrometers so that it may become 40 % of the weight to the sum total of this resin and this bead.
[0040] Optical diffusion layer 8b is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about the bead of polymethylmethacrylate with a diameter of 15 micrometers so that it may become 20 % of the weight to the sum total of this resin and this bead. Optical diffusion layer 8c is fabricated to the polycarbonate resin of a melt index (290 degrees C, 1.9kg) 5.0 from arrangement **** which adds and becomes about a glass bead with a diameter of 30 micrometers so that it may become 10 % of the weight to the sum total of this resin and this bead.
[0041] [Example 6] The surface light source equipment to be used is the same as an example 1 except for a modulated light sheet. The modulated light sheet 7 consists of a condensing layer 9 made from a polycarbonate by which the laminating was carried out to the optical diffusion layered product 8 and its outgoing radiation side of the two-layer structure by the optical diffusion layers 8a and 8b made from polymethylmethacrylate as shown in drawing 7 . The non-laminating side of the condensing layer 9 is the concave convex 10. The shape of this toothing consists of many concave protruding lines of the shape of a cross-section abbreviation sine wave arranged in parallel with the fluorescent lamp 1 in drawing 1 . The amplitude of the sine wave of a concave protruding line is 120 micrometers, a period is 350 micrometers, and the thickness of the condensing whole layer is 200 micrometers.
[0042] The condensing layer 9 consists of a polycarbonate of a melt index (290 degrees C, 1.9kg) 4.0. Independent extrusion performed shaping of the condensing layer 9. The heat press performed concavo-

convex formation. The thickness of optical diffusion layer 8a is 10 micrometers, the thickness of optical diffusion layer 8b is 60 micrometers, and the thickness as the optical whole diffusion layer is 70 micrometers.
[0043] After optical diffusion layer 8a applies to the non-concave convex of the condensing layer 9 arrangement **** which adds and becomes to the monomer of methyl methacrylate so that it may become 25 % of the weight to the sum total of this monomer and this bead about polystyrene beads with a diameter of 6 micrometers, it carries out heat curing of this monomer, and forms it. After optical diffusion layer 8b applies to the non-laminating side of optical diffusion layer 8a arrangement **** which adds and becomes to a methyl methacrylate monomer so that it may become 15 % of the weight to the sum total of this monomer and this bead about polystyrene beads with a diameter of 40 micrometers, it carries out heat curing of this monomer, and forms it.
[0044] [Example 1 of a comparison] In drawing 1 , the edge light-type surface light source equipment which nothing sandwiches between a light guide plate 6 and the liquid crystal display component 2 was constituted.
[Example 2 of a comparison] In the modulated light sheet 7 of the example 1 shown in drawing 2 , the surface light source equipment of an edge light method was constituted using the optical diffusion layers 8a and 8b which do not contain a light diffusion agent slack bead.
[0045] [Example 3 of a comparison] In the modulated light sheet 7 of the example 1 shown in drawing 2 , it did not have the condensing layer 9, i.e., edge light-type surface light source equipment was constituted using the sheet of only the optical diffusion layers 8a and 8b.
[Example 4 of a comparison] The irregular concave convex of 120 concavo-convex consistencies/inch was formed in the light exiting surface of a polycarbonate film with a thickness of 250 micrometers in a depth of 150 micrometers by the melt index (290 degrees C, 1.9kg) 3.0. In this way, edge light-type surface light source equipment was constituted using the obtained optical diffusion sheet.
[0046] [Example 5 of a comparison] In the modulated light sheet of the example 3 shown in drawing 4 , edge light-type surface light source equipment was constituted using the sheet whose optical diffusion layer is a monolayer of only 8a and whose thickness of this optical diffusion layer is 50 micrometers.
[0047] [Evaluation trial of the engine performance] In drawing 1 , 3.5mm of sizes and the cold cathode tube 1 with a die length of 135mm are arranged as the light source on the side face of a light guide plate 6 in which it has a dot pattern 5 at a tooth back. A light guide plate 6 consists of 196mm wide, 135mm long, and a polymethylmethacrylate plate with a thickness of 2.5mm. The reflecting plate 4 has been arranged at the tooth-back side of a light guide plate 6, and each sheet 7 of an example and the example of a comparison is formed in the front-face side of a light guide plate 6. A reflecting plate 4 consists of an opaque film made from opaque polyethylene terephthalate.
[0048] In this way, the constituted edge light-type surface light source equipment was driven with the inverter of direct-current 12V, and the modulated light sheet was evaluated. Evaluation criteria are the following two kinds.
(1) Brightness with an angle of visibility of 2 degrees was measured from the location left 30cm in the direction of a normal in the fixed point on the brightness screen of a screen (nine places), and it considered as the data of brightness.
[0049] (2) When a modulated light sheet surface was seen from the location distant from the visibility screen of a dot pattern 50cm in the direction of a normal, it evaluated whether a dot pattern would be checked by looking. The evaluation result in the above conditions is shown in Table 1.
[0050]
[Table 1]

ID=000003

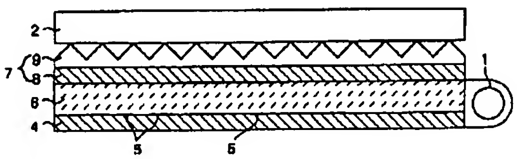
[0051]
[Effect of the Invention] In the modulated light sheet according to this invention like [explanation / above-mentioned / it is ****** and] It is spread while the light which carried out incidence with the distribution which is [of a screen] separated from a normal can change a travelling direction a lot in the high thing light diffusion layer of a refraction degree. The homogeneity of diffusion can be raised in the low optical diffusion layer of a refraction degree after that. And a non-laminating side, That is, since the Idemitsu distribution is condensed near the normal by passing the condensing layer currently made with the concave convex in the outgoing radiation side, the function of both sheet thickness's lightness maintenance of optical diffusion and a screen is demonstrated efficiently, and this modulated light sheet is contributed to the thinning of surface light source equipment, and high performance-ization.

[Translation done.]

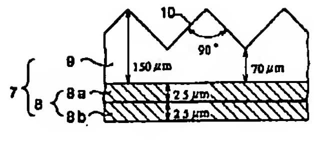
7　調光シート
8　光拡散層積層体
8a、8b、8c　光拡散層

9　集光層
10　凹凸面

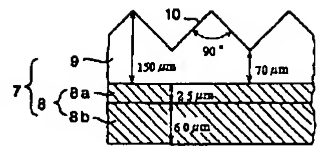
【図1】



【図2】



【図5】



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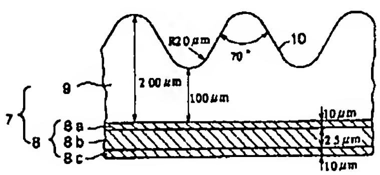

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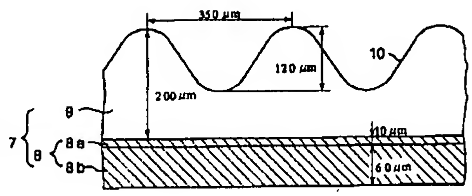

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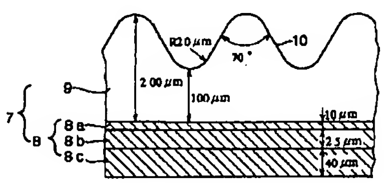

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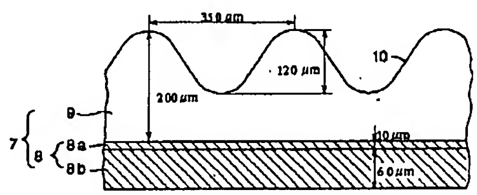

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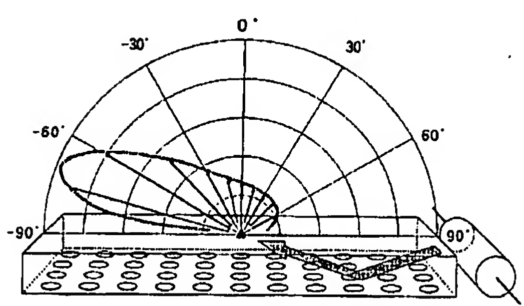
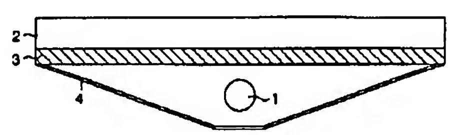


【図9】



【図10】